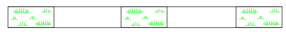
Non-Structural Low Impact Development Controls

Vegetated Conveyance Systems

Plan Symbol



Description

Vegetated conveyances are designed and installed as an alternative to curb and gutter and hard piping storm water conveyance systems. Open vegetated conveyances improve water quality by providing partial pollutant removal as water is filtered by the vegetation and by the opportunity to infiltrate into the soil. Open vegetated conveyances also are designed to reduce flow velocities when compared to hard piping systems.

When and Where to Use It

Open vegetated conveyance systems are incorporated into moderate to low density development sites where land is available and where the land surface is gently sloping (less than 5 percent). The soil must be able to withstand the design tractive forces and flow velocities of the open conveyance, or an applicable

Design Criteria

Design Turf Reinforcement Mats or Erosion Control Blankets to protect the open conveyance. Install a dense cover of strong rooted vegetation in the conveyance systems. For maximum water quality benefits, design vegetated open conveyances with a flat longitudinal slope to promote low velocity flow.

Installation

Construct vegetated conveyances with trapezoidal or parabolic cross section with relatively flat side slopes (flatter than 3H:1V).

Install a flat bottom between 2 and 8 feet wide.

During construction, it is important to stabilize the channel before the turf has been established, either with a temporary grass cover or with the use of natural or synthetic erosion control products.

Inspection and Maintenance

- The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely.
- The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.
- Maintenance includes periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, re-seeding of bare areas, and clearing of debris and blockages.
- Remove accumulated sediment manually to avoid the transport of resuspended sediments in periods of low flow and to prevent a damming effect from sand bars. Minimize the application of fertilizers and pesticides.
- Repair damaged areas within a channel.
- Inspect for a healthy thick grass cover. Re-seed as necessary.

Stream Buffers

Description

A stream buffer is an area along a shoreline, wetland or stream where development is restricted or prohibited. The primary function of the buffer is to physically protect and separate a stream, lake, or wetland from future disturbance or encroachment.

The general function of the buffer is to:

- Protect the overall stream quality by providing shade for the stream and provide wildlife habitat.
- Remove pollutants, sediments, bacteria, and excess nutrients from storm water runoff through infiltration and filtering.
- Help detain and slow down flow rates from developed areas.
- Provide a setback from the stream to prevent damage to structures or improved property due to flooding or changes in the stream channel.

When and Where to Use It

Effective water quality protection stream buffers consist of undisturbed natural vegetation including maintaining the original tree line along the stream or channel banks. Promptly stabilize disturbed buffers with a dense cover of strong rooted grasses, native plants, and native trees.

Buffer Classification

Major streams, drainageways and waterbodies are recommended to have buffer protection. Buffer recommendations are based on the following classifications:

Class 1: Streams thhave a drainage area greater than or equal to 100 acres.
Class 2: Streams that have a drainage area greater than or equal to 300 acres.
Class 3: Streams that have a drainage area greater than or equal to 640 acres.

Stream Buffer Recommendations

Stream Class	Stream Side Zone (ft)	Managed Use Zone (ft)	Upland Zone (ft)	Total Buffer Width on Each Side of the Stream (ft)
1	30	None	15	45
2	30	20	15	65
3	30	45	25	100

**All buffer widths are measured from the top of the streambank.

Stream Side Zone

This zone is the closest to the stream and this area and remains undisturbed. The stabilization and protection of this zone is critical to water quality. Clearing and cutting of vegetation is prohibited in this zone with the desirable vegetation being mature forest. Use of this zone includes flood control structures, streambank stabilization and restoration, footpaths, and utility or road crossings.

Managed Use Zone

This area provides space for the storage of floodwaters and the filtering of pollutants. A limited number of trees may be removed from this zone provided that the remaining tree density is a minimum of eight healthy trees of a minimum 6-inch caliper per 1,000 square feet. The vegetative target for this zone is managed forest but turfgrass can also be a vegetative target. Do not place fill materials in this area, and do not conduct grading and other land disturbing activities. Some storm water BMPs, greenway trails and bike paths may be designed in this area.

Upland Zone

This zone is located furthest from the streambank. Grading is permitted in this zone, in a manner that does not damage the roots of the trees located in the adjacent Managed Use Zone. Grass or other suitable ground covers may be planted in this zone. Do not place fill material in the Upland Zone unless the replacement of deficient soil is required. The volume of fill material shall not exceed the volume of deficient soil removed. Personal gardens, gazebos, decks, and storage building less than 150 square feet in size are permitted in the Uplands Zone.

Buffer Design Requirements

For optimal storm water treatment, the following buffer designs are recommended:

- The buffer consists of three lateral zones; Stream Side, Managed Use and Upland Zones.

- The buffer has a storm water depression area that leads to a grass filter strip before entering the Managed Use Zone. Design the storm water depression to capture the first flush runoff from the site and bypass larger storm flows directly to the receiving water body.

- Spread the captured runoff across a grass or wooded filter in a sheet flow condition. The forest buffer of the Stream Side and Managed Use Zones infiltrates the sheet flow and does not discharge any surface runoff to the receiving water body.

Buffer Maintenance

An effective buffer management plan includes establishment, management, and distinctions of allowable and unallowable uses in each Zone. Buffer boundaries are well defined and clearly marked during, and after construction is complete. Buffers designed to capture storm water runoff from urban areas require more maintenance if the first zone is designated as a bioretention or other engineered depression area.

Disconnected Rooftop Drainage to Pervious Areas

Description

Disconnected rooftop drainage reduces the runoff flow rates from developed areas. The disconnection involves directing storm water runoff from rooftops towards pervious areas where it is allowed to filter through vegetation and other landscaped material and infiltrate into the soil. Use erosion control devices such as splash blocks or level spreaders at the downspout discharge point to transfer the flow from concentrated flow to sheet flow.

Disconnected rooftop drainage has the following benefits:

- Increase the time of concentration by disconnecting runoff from any structural storm water drainage systems.
- Provide water quality benefits by allowing runoff to infiltrate into the soil. Downspouts from rooftops should discharge to gently sloping, well-vegetated areas, vegetated filter strips, or bio-retention areas.

When and Where to Use It

This practice is applicable and most beneficial in low-density residential or commercial developments having less than 50 percent impervious area. Disconnection is not applicable to large buildings where the volume of runoff from the rooftops will cause erosion or degradation to receiving vegetated areas.

Cluster Development

Description

Cluster development practices concentrate development away from environmentally sensitive areas such as streams, wetlands, and mature wooded areas. The clustering of development in one area reduces the amount of roadways, sidewalks, and drives required when compared to development sprawled over the entire land area.

Install clustering and conservation of natural area practices at least to some extent on all development sites not only to reduce the impacts to natural resources by minimizing disturbance and impervious areas, but also to maintain some of the natural beauty of the site.

Reducing the amount of disturbed area and impervious area reduces the amount of runoff volume treated for water quantity and water quality control. Concentrating development away from environmentally sensitive areas will also reduce the amount of time and expenses to get federal and state permits for impacting jurisdictional waters.

Concentrate development on the flattest part of the development parcel away from environmentally sensitive areas such as steep slopes, streams, and wetlands. This reduces the impacts to these areas, and reduces the amount of earth moving necessary for the development.

Natural Infiltration

Description

Natural infiltration is a method in which an undisturbed land area covered with natural vegetation accepts runoff from new development and infiltrates the runoff into the soil.

When and Where to Use It

Use natural infiltration areas only where the soils are suitable. The area is typically in a forested condition with the land surface covered by leaves, pine needles, and other forest floor organic materials. Natural infiltration areas are designated for passive recreation only.

Design Criteria

Use a natural infiltration area as a storm water quality control if it meets the design criteria of this section. The size of a natural infiltration area is calculated using the following equation:

$$A = \frac{(K\ T\ I)}{[(cd) - K]}$$

Where:

A	=	Natural infiltration area required (acres)
K	=	Runoff volume to infiltrate (inches)
T	=	Total site area or total drainage area (acres)
I	=	Built upon area ratio (Built upon area / T)
c	=	Effective water capacity (in/in), should be determined from site-specific soil samples.
d	=	Depth of soil A horizon (inches), should be determined from site-specific soil samples.

Runoff enters the infiltration area as sheet flow with a non-erosive velocity. Stabilize and vegetate the areas draining to the Natural Infiltration area a minimum of 20-feet in length.

Natural infiltration areas have the following characteristics:

- Appropriate soils that have a minimum infiltration rate of 0.3-inches per hour, low erosion potential, and good drainage (not in a wetland or floodplain).
- Mature forest cover (if the natural infiltration area (A) is not located in a mature forest, then double the area of that calculated by the equation above).
- Slopes less than 10 percent.
- Remains permanently undisturbed.

The limitations of natural infiltration areas include:

- Not suitable for soils that have greater than 30 percent clay content or greater than 40 percent clay and silt content.
- Not suitable in areas with high water tables or shallow depth to highly impervious strata such as bedrock or clay layers.
- High sediment loadings or lack of maintenance clogs the surface layer therefore inhibiting any water infiltration into the soil.